

# Can training in musculoskeletal examination skills be effectively delivered by undergraduate students as part of the standard curriculum?

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## Abstract

**Objectives.** There is a need to improve competence of musculoskeletal system (MSS) examination in medical students and junior doctors. Peer-assisted learning (PAL) is a technique whereby students learn from and with each other. This study aimed to determine whether PAL can be integrated into standard undergraduate medical curricula to improve MSS examination using the gait, arms, legs, spine (GALS) screening tool.

**Methods.** Fifty final-year students (trainers) were trained using GALS for MSS examination while attending a standard clinical medical attachment at Glasgow Royal Infirmary. These students delivered GALS training to a further 159 students (trainees). Pre/post-confidence questionnaire (100-mm visual analogue scale) and written feedback were obtained. Final Objective Structured Clinical Examination (OSCE) scores from an MSS station were compared with a control group of 229 students randomized to other hospitals for the standard MSS training.

**Results.** Analysis of completed trainer questionnaires (30/50) showed increased confidence in all parts of GALS after training [ $<47$  (19) cf.  $>88$  (12);  $P < 0.005$ ]. Similarly, confidence in trainees (136/159) who answered the questionnaire increased [ $<43$  (19) cf.  $>85$  (15);  $P < 0.005$ ]. Written comments highlighted that students would recommend PAL. OSCE results showed 84% (192/229) of students in the control group passed the MSS station, with 87% (139/159) of trainees ( $P = 0.3$ ) and 100% (50/50) of trainers ( $P < 0.01$ ).

**Conclusions.** MSS examination skills are improved by integrating PAL into the undergraduate medical curriculum, with student confidence being increased, and higher OSCE scores.

**Key words:** GALS, Peer learning, Curriculum.

## Introduction

Undergraduate students are not confident in examining the musculoskeletal system (MSS) at the time of graduation. Indeed, compared with all other systems of the body, their confidence is lowest in the MSS examination [1]. This problem translates to the postgraduate setting and is manifest by the lack of MSS examinations on

patients, or its poor documentation [2–4]. The implication is that patients are being sub-optimally assessed and under-diagnosed. Considering that musculoskeletal problems are one of the commonest reasons for presentation to a General Practitioner, the issue of training becomes even more pertinent [5]. This is at a time when the overall period allocated in the undergraduate curriculum for rheumatology has declined since the publication of *Tomorrow's Doctors* [6, 7].

The introduction of the gait, arms, legs, spine (GALS) system has allowed a validated and systematic screening process to be implemented, but problems remain [8, 9]. Most physicians enjoy teaching undergraduates, but pressures on time due to contractual obligations can frustrate participation in this key activity [10]. In addition, the MSS can be perceived as being less important because some

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general physicians do not regard it as part of routine medical practice [6], and therefore if MSS is taught by non-specialists it is unlikely to take a high priority. Enhancing undergraduate MSS learning and particularly examination skills is, therefore, cardinal for improving diagnostic acumen and referral patterns in practicing doctors. One innovative approach has been to utilize patient educators (PEs), who can be as effective when teaching as rheumatology consultants. However, use of PEs is limited by the lengthy training required, demand on trainers time and financial resources [11].

Clinical skills have been augmented by the use of peer-assisted learning (PAL) in several professions including medicine, [12] nursing [13] and physiotherapy [14, 15], allowing students to help their colleagues with teaching and learning support [16, 17]. Recognized advantages of PAL for student trainers include greater familiarity with their courses compared with faculty and readiness to integrate new learning experiences in context. In addition, trainers are deemed to be more approachable by their trainees [18]. Peer interaction also improves self-esteem, commitment to work and promotes mutual concern among participants [17].

There have been encouraging data from reports of the use of PAL in clinical examination, but these have all either been for self-selecting students, who have chosen to participate in small randomized studies or as part of a student-selected component (SSC) [15, 19]. The aim of this study was to determine if PAL could improve MSS examination skills using GALS in final-year medical students, as an integrated part of the curriculum.

## Methods

### Curriculum training

At the University of Glasgow, all students take part in standard clinical skills training in the MSS examination commencing in Year 1 when students learn about the range of joint movements. In Year 2, students watch a GALS video and practice this examination on each other guided by vocational tutors. In Year 3, students gain further experience by examining patients with clinical problems using GALS. This forms the basis for student learning before exposure to patients during hospital and General Practitioner attachments in Years 4 and 5.

Final-year medical students are randomly allocated for 5-week attachments to medical units in different hospitals. In Glasgow Royal Infirmary (GRI) there are five medical units, one of which covers rheumatology. From September 2006 to June 2008, sequential groups of four to six students attached to the rheumatology unit were invited to participate as trainers in the PAL project as an adjunct to their standard training for MSS examination. Before a faculty-led [specialist registrar (SpR) or physiotherapist] training session, students were asked to review the GALS video. Use of GALS was then demonstrated in a 90-min tutorial using normal subjects. An interactive model was used, with students repeatedly examining each other using the GALS tool and asking questions to

a point where they were regarded as competent in GALS use by the supervisor. During the remainder of the attachment, these student trainers demonstrated GALS using similar techniques to the four remaining groups that were attached to the other units. Students were supervised in this for their first session by the facilitator to ensure consistency. Each group of trainers, therefore, undertook one training session and four teaching sessions, whereas the trainees only undertook a single training session. All students also had access to an audiovisual GALS examination demonstration via the university web site for revision purposes.

### Trainer evaluation

To evaluate the teaching programme, two questionnaires were employed. Student trainers were offered questionnaires to assess confidence in use of each component of GALS using a 100-mm visual analogue scale. The pre-training questionnaire was completed before GALS training and the post-training questionnaire at the end of their 5-week attachment. All trainers were given an opportunity to provide free-text comments regarding good and bad aspects of the training session at the end of their 5-week block. The responses were coded into similar groupings for analysis [20].

All students undergo an Objective Structured Clinical Examination (OSCE) at the end of final year. This OSCE contains clinical skills stations including one assessing examination of the MSS in patients with rheumatic diseases, with marks being allocated for correct use of the GALS technique for the examination of the upper or lower limb and achieving an appropriate diagnosis. A comparison of marks and pass rates obtained by student trainers, trainees and those who had undertaken standard curriculum training at different hospital sites (control group) was performed using chi-square analysis.

All OSCE examiners undergo general training in examination technique. The five MSS examiners (one for each hospital site where the examination was held) developed a standardized OSCE scoring system based on GALS screening for the MSS question. This allowed the group to decide on a score required to achieve a pass and to ensure a reliable assessment of each student. Before the student's assessment, the examiners were required to examine the patient using the GALS technique to ensure fairness of the examination question and to become familiar with the clinical signs that could be elicited.

### Trainee evaluation

The student trainees were invited to complete confidence questionnaires before and after the single training session. Examination results from the MSS station in the OSCE were examined to assess for any differences in pass/fail results as a consequence of participating as a PAL trainee.

### Statistical analysis

Data were stored and processed into SPSS for Windows 11.5.0. and Minitab. Wilcoxon signed rank test and chi-square analyses were performed comparing pass

rates between the three groups. ANOVA, Kruskal-Wallis and pair-wise comparisons were made for the raw exam scores.

### Ethics

Ethics approval was obtained for this study from the University of Glasgow Ethics Committee.

### Results

Figure 1 shows a diagram illustrating the distribution of students in each of the three study groups and the numbers participating in evaluation.

#### PAL trainers

Fifty students (Fig. 1) attended the rheumatology unit at GRI with all (100%) providing written informed consent to become trainers. Table 1 shows data from 30 trainers (60%) who completed pre- and post-training confidence questionnaires. Student trainers were more confident in undertaking all aspects of the GALS screening examination subsequent to their training [Table 1 <47 (s.d. 19) before PAL training cf. >88 (s.d. 12) after PAL training  $P < 0.005$ ].

Free-text comments from 19 (38%) student trainers were received after their 5-week attachment to rheumatology with 12 producing more than one remark. Positive comments included that training improved learning about MSS examination skills (13), general confidence (7) and benefits of working in a relaxed setting in small groups (3). Smaller numbers (1–2) commented on improved presentation and communication skills noting the benefits of students training students. Concerns raised included that

PAL was time consuming (2), trainers needed to be confident about the subject matter (2) and some students were not happy being taught by their peers (2). Other individual comments included timing of the session, poor trainee attendance, preference for SpR teaching and a desire for the examiners OSCE marking sheet in order to assess the performance.

#### PAL trainees

PAL training was made available to all students (Fig. 1) who attended the GRI ( $n = 192$ ). Of these, 159 (83%) signed consent forms to become PAL trainees. Table 1 shows that confidence among the 136 trainees who fully completed the questionnaire, increased from <43 (19) to >85 (15) after training by their peers ( $P < 0.005$ ).

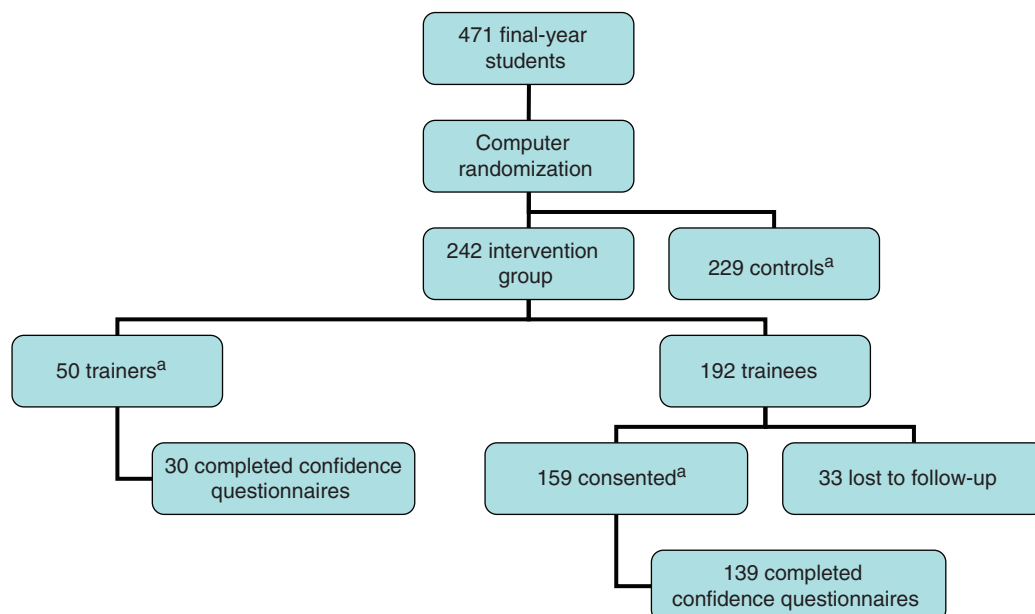
The remaining 33 students (17%) either did not attend the training session, failed to adequately fill out the consent form or did not sit the final-year OSCE examination. Some students did not wish to identify themselves at the time of training and so it was not possible to determine the exact rate of non-attendance.

#### Examination results

Results at the final-year MSS OSCE station were compared for the 50 trainers, 159 trainees and 229 control students, who had undertaken standard training at different hospital sites (Table 2).

Chi-squared comparisons demonstrated that of the control group, 84% (192/229; Fig. 1) passed the MSS OSCE station, with 87% (139/159) of student trainees also passing, but this failed to reach statistical significance ( $P = 0.3$ ). Finally, 100% (50/50) of student trainers

Fig. 1 Summary diagram of student participation over a 2-year period. <sup>a</sup>All students in these groups completed OSCE.



**TABLE 1** Confidence questionnaires

GALS parameters	Pre-training mean	Post-training mean	P-value
<b>Trainers</b>			
History taking	53 (11)	80 (16)	<0.005
Gait	49 (19)	85 (14)	<0.005
Arms	53 (16)	84 (15)	<0.005
Legs	58 (15)	86 (12)	<0.005
Spine	47 (19)	88 (12)	<0.005
<b>Trainees</b>			
History taking	48 (20)	77 (17)	<0.005
Gait	45 (18)	85 (12)	<0.005
Arms	52 (18)	85 (13)	<0.005
Legs	52 (19)	85 (12)	<0.005
Spine	43 (19)	85 (15)	<0.005

Student trainer/trainee confidence [mean (s.d.)] in examination of the MSS before and after PAL training as measured by visual analogue scale (1–100 mm).

**TABLE 2** Final-year OSCE results expressed as numbers and percentage of students passing the MSS OSCE station

Trainers, n (%)	Trainees, n (%)	Standard training group, n (%)
50/50 (100)	139/159 (87)	192/229 (84)

Statistical analysis—trainees:  $P=0.008$ ; trainers: non-intervention  $P=0.002$ ; trainees: non-intervention  $P=0.3$ .

passed the MSS examination question, more than the trainees ( $P=0.008$ ) and control group ( $P=0.002$ ).

ANOVA test for differences between raw marks in the three groups showed significant differences between trainers and controls. Due to the presence of outliers, Kruskal–Wallis (non-parametric) testing was undertaken confirming significance ( $P=0.008$ ). Finally, pair-wise comparisons (based on ANOVA) showed significant differences between trainers mean and controls mean (CI for difference: 0.391, 2.197) and between trainers mean and trainees mean (CI for difference: 0.007, 1.883). No significant difference was found between trainees mean and controls mean (CI for difference:  $-0.248$ , 0.945).

## Discussion

This is the largest study undertaken assessing examination skills in medical students by peer learning. Randomization has allowed non-selective groups of student trainers to improve their musculoskeletal examination skills as part of a standard curriculum attachment to a medical unit. The majority of students (51%) in each year received additional training in use of GALS to examine the MSS.

After triangulating data from questionnaires and examination results, final-year student trainers gain confidence

in their ability to examine the MSS, and all 50 (100%) passed the OSCE MSS station. This supports data from previous studies where extra training was offered as part of an SSC to smaller student groups [21]. Results from student trainees showed an increase in confidence in using GALS to screen the MSS but the pass mark attained at MSS OSCE station, although higher (87%) than the alone control group (84%), was not statistically different.

Initial studies incorporating GALS PAL training where Year 2 students were studied as part of an SSC, the pass mark for the control group was only 67% as compared with 84% in this study. This increase could result because different year groups have been analysed, but, alternatively, final-year students could be increasingly aware that GALS screening is the favoured method of assessment for MSS examination and are studying GALS more effectively. The 100% pass rate for trainers may result from more effective learning, improved confidence and frequency of teaching GALS using PAL. Although the confidence in the use of GALS increases similarly for trainers and trainees after training, the repetition of teaching involved in PAL may account for the difference in OSCE examination scores between the two groups. Whatever the cause, the OSCE score improvement across the whole student population indicates that students are being increasingly provided with the required skills to examine MSS patients more effectively. Analysis at post-graduate level would be required to determine whether improved patient assessment occurs in clinical practice.

In addition to increasing confidence in the use of GALS, and improving examination results, trainers commented positively in the free-text comments about the additional value of generic skills gained during PAL. These included improved communication skills, presentation skills and an increased ability to work in small groups. Time to train students as teachers can be difficult to find in crowded curricula [22] but all these benefits accrued from an investment of only 90 min/week. Moreover, these attributes are all highly relevant for personal development and are required by the General Medical Council of *Tomorrow's Doctors* [7].

The results of this study are particularly pertinent because students were not selected to be trainers, being randomly chosen by computer to attend the rheumatology unit at GRI. Some previous studies could have introduced bias by selecting students based on academic achievement [23] or following financial incentives [24]. These interventions showed that PAL is of benefit for these selected groups of students but did not address whether either inducement was relevant to the outcome. The students in this study were neither selected by academic ability, nor given financial incentives. The analysis herein confirms the hypothesis that unselected students can be effective trainers, delivering relevant, valuable tuition in the absence of faculty expense and potentially allowing hard-pressed clinical staff more time to address other aspects of their job plans.

There are a number of limitations to this study. First, is the training delivered towards the end of the 5-week



programme as reliable as that delivered at the start? Ensuring consistency in long-term studies requires careful monitoring, but as this was only a short-term programme this possibility was considered relatively small and was not specifically investigated. Secondly, confidence levels in the control group were not specifically studied. It is possible that the student trainers had a higher baseline confidence compared with the controls. However, randomization makes this unlikely and in previous analyses of control populations in PAL studies, baseline confidence has always been similar [19]. Thirdly, a larger response rate from trainers completing free-text comments would have been valuable. In addition, collection of free-text comments could have been extended to the trainees but because of anticipated difficulties with data collection for this group it was determined to focus primarily on the student trainers. Nevertheless, substantial returns from confidence questionnaires and the examination results together are supported by the free-text comments, indicating that PAL is beneficial for both groups of students.

Fourthly, it is possible that tuition by non-specialists may not be as effective as that delivered by faculty. However, a number of studies have suggested this is not the case. One approach is the use of PEs who can train students in MSS examination techniques [11] and outcomes are no different when compared with training delivered by the specialist staff. Small randomized studies of clinical skills showed that PAL by students was in no way inferior to faculty teaching [15, 21, 23], a result confirmed by this much larger randomized study. However, the advantages of PAL over that delivered by PEs are that the students develop valuable generic skills and have an opportunity to prepare for their future role as educators [25]. In addition, there is a positive correlation between undergraduate experience of rheumatology and with future career choice. Peer learning about the MSS may, therefore, improve both the quality and quantity of recruits to the specialty [26].

In conclusion, final-year students at the time of graduation are least confident in undertaking MSS examination when compared with all other systems. To limit sub-optimal patient assessment it is necessary to improve confidence and competence of students in MSS examination techniques. Integrating PAL based on GALS into the standard curriculum improves confidence, results in higher examination scores and, in addition, enhances the generic skills necessary to practice as a physician. As such, PAL could be usefully extended to study of the Regional Examination of the MSS (REMSS) [27], joint aspiration [28] and other clinical skills.

#### Rheumatology key messages

- Musculoskeletal clinical examination can be improved in medical students by PAL.
- Students on a standard rheumatology attachment can effectively deliver additional GALS training using PAL.

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